

Express Mail Label No. EH 826 055 808 US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

UTILITY APPLICATION AND FEE TRANSMITTAL (1.53(b))

ASSISTANT COMMISSIONER FOR PATENTS

Box Patent Application

Washington, D.C. 20231

Sir:

Transmitted herewith for filing is the patent application of

First named Inventor

or Application Identifier: Denis Menard et al.

For:

FRICTION MATERIAL DESIGNED FOR FITTING TO A DEVICE EMPLOYING  
FRICTION IN A LIQUID MEDIUM, AND A METHOD OF PRODUCING SUCH  
A FRICTION MATERIAL AND THE DEVICE TO WHICH IT IS FITTED

Enclosed are:

☒ 12 page(s) of specification, 1 page(s) of Abstract, 5 page(s) of claims

☒ 4 sheets of drawing ☒ formal ☐ informal

☒ 1 page(s) of Declaration and Power of Attorney

☐ Unsigned

☐ Newly Executed

☒ Copies from prior application

☐ Deletion of inventors including Signed Statement under 37 C.F.R. § 1.63(d)(2)

☒ Incorporation by Reference: The entire disclosure of the prior application, from which a copy of the combined declaration and power of attorney is supplied herein, is considered as being part of the disclosure of the accompanying application and is incorporated herein by reference.

☐ Microfiche Computer Program (Appendix)

☐ \_\_\_\_\_ page(s) of Sequence Listing

☐ computer readable disk containing Sequence Listing

☐ Statement under 37 C.F.R. § 1.821(f) that computer and paper copies of the Sequence Listing are the same

- ☐ Certified copy of Priority Document(s)
- ☐ English translation documents
- ☒ Information Disclosure Statement
- ☐ Copy of \_\_\_\_ cited references
- ☒ Preliminary Amendment
- ☒ Return receipt postcard (MPEP 503)
- ☐ Assignment Papers (assignment cover sheet and assignment documents)
- ☐ A check in the amount of \$40.00 for recording the Assignment.
- ☒ Assignment papers filed in parent application Serial No. 08/553,573.
- ☐ Certification of chain of title pursuant to 37 C.F.R. § 3.73(b).
- ☒ This is a ☒ continuation ☐ divisional ☐ continuation-in-part (C-I-P) of prior application serial no. 08/553,573.
- ☐ Cancel in this application original claims \_\_\_\_\_ of the parent application before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)
- ☐ A Preliminary Amendment is enclosed. (Claims added by this Amendment have been properly numbered consecutively beginning with the number following the highest numbered original claim in the prior application.
- ☒ The status of the parent application is as follows:
- ☒ A Petition For Extension of Time and a Fee therefor has been or is being filed in the parent application to extend the term for action in the parent application until March 22, 1998.
- ☐ A copy of the Petition for Extension of Time in the co-pending parent application is attached.
- ☐ No Petition For Extension of Time and Fee therefor are necessary in the co-pending parent application.
- ☐ Please abandon the parent application at a time while the parent application is pending or at a time when the petition for extension of time in that application is granted and while this application is pending has been granted a filing date, so as to make this application co-pending.
- ☐ Transfer the drawing(s) from the parent application to this application.
- ☒ Amend the specification by inserting before the first line the sentence:  
This is a ☒ continuation ☐ divisional ☐ continuation-in-part of co-pending application Serial No. 08/553,573 filed November 27, 1995, herein incorporated by reference.

## I. CALCULATION OF APPLICATION FEE

	Number Filed		Number Extra		Rate	Basic Fee
Total						\$ 790.00
Claims	30	-20=	10	x	\$22.00	\$220.0
Independent						
Claims	3	- 3=	0	x	\$82.00	\$ 0.0
Multiple Dependent Claims						
	[ ] yes		Additional fee		= \$270.00	\$
	[ X ] no		Additional fee		= NONE	

Total: \$1,010.00

- [ ] A statement claiming small entity status is attached or has been filed in the above-identified parent application and its benefit under 37 C.F.R. § 1.28(a) is hereby claimed. Reduced fees under 37 C.F.R. § 1.9(F) (50% of total) paid herewith \$\_\_\_\_\_.
- [ X ] A check in the amount of \$ 1,010.00 in payment of the application filing fees is attached.
- [ ] Charge Fee(s) to Deposit Account No. 13-4500. Order No. \_\_\_\_\_. A DUPLICATE COPY OF THIS DOCUMENT IS ATTACHED.
- [ X ] The Assistant Commissioner is hereby authorized to charge any additional fees which may be required for filing this application, or credit any overpayment to Deposit Account No. 13-4500, Docket No. 1948-4293 US1. A DUPLICATE COPY OF THIS DOCUMENT IS ATTACHED.

Respectfully submitted,

MORGAN &amp; FINNEGAN, L.L.P.

Dated: March 11, 1998By: 

Ian G. DiBernardo

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 Rev. 1/16/98

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03/11/98  
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PATENT

Docket No. 1948-4293 US1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s) : Menard et al.  
Serial No. : TBA                      Group Art Unit : 1314  
Filed : March 11, 1996              Examiner : K. Choi  
For : **FRICITION MATERIAL DESIGNED FOR FITTING TO A DEVICE  
EMPLOYING FRICTION IN A LIQUID MEDIUM, AND A METHOD OF  
PRODUCING SUCH A FRICTION MATERIAL AND THE DEVICE TO  
WHICH IT IS FITTED**

EXPRESS MAIL CERTIFICATE

Express Mail Label No. EH 826 055 808 US

Date of Deposit March 11, 1998

ASSISTANT COMMISSIONER FOR PATENTS

**Box Patent Application**

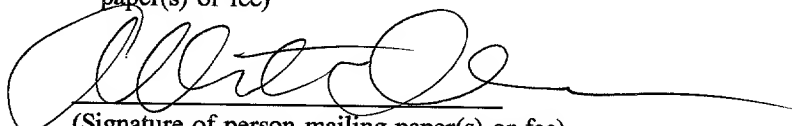
Washington, D.C. 20231

Sir:

I hereby certify that the attached Utility Application and Fee Transmittal enclosing 12 pages  
of specification, 5 pages of claims, 1 page of Abstract, and 4 sheets of formal drawings (Figs. 1-4); Previously  
filed Declaration (executed); Information Disclosure Statement; Form PTO-1449; a check in the amount of  
\$1,010; Preliminary Amendment; and Return Postcard and this Express Mail Certificate, is being deposited with  
the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. §1.10 on the  
date indicated above and is addressed to the Assistant Commissioner of Patents and Trademarks, Box Patent  
Application, Washington, D.C. 20231.

Albert Isles

(Typed or printed name of person mailing  
paper(s) or fee)



(Signature of person mailing paper(s) or fee)

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PATENT

DOCKET NO. 1948-4293 US1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Menard et al. Group Art Unit: TBA  
Serial No. : TBA Examiner: TBA  
Filed : March 11, 1998  
For : FRICTION MATERIAL DESIGNED FOR FITTING TO A  
DEVICE EMPLOYING FRICTION IN A LIQUID MEDIUM,  
AND A METHOD OF PRODUCING SUCH A FRICTION  
MATERIAL AND THE DEVICE TO WHICH IT IS FITTED

Assistant Commissioner for Patents  
BOX PATENT APPLICATION  
Washington, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Please enter the following Preliminary Amendments in  
the above-referenced application prior to examining the  
application.

In The Specification:

Page 1, after the title, insert --Field of the  
Invention--.

Page 1, line 5, delete "object of the".

Page 1, line 5, delete "is" and substitute therefor  
--relates to--.

Page 1, after line 15, insert --Background of the  
Invention--.

Page 1, line 21, delete "They" and substitute therefor --Such materials--.

Page 1, line 25, delete "millimetre" and substitute therefor --millimeter--.

Page 2, line 8, delete "this" and substitute therefor -the above described--.

Page 2, line 8, after "unlike" insert --with--.

Page 2, line 14, delete "price".

Page 2, after line 15 insert --Summary of the Invention--.

Page 2, line 22, delete "characterised" and substitute therefor --characterized--.

Page 2, line 24, delete "said".

Page 3, line 19, delete "characterised" and substitute therefor --characterized--.

Page 3, line 25, after "resin:" insert --and--.

Page 4, line 6, delete "." and substitute therefor --;--.

Page 4, line 9, delete "." and substitute therefor --;--.

Page 4, line 18, delete "characterised" and substitute therefor --characterized--.

Page 5, line 13, before "ring" delete "said".

Page 6, line 11, delete "which" and substitute therefor --.---.

Page 6, line 12, delete "depict:"

Page 6, after line 12, insert --Brief Description of the Drawings--.

Page 6, line 13, delete "- in".

Page 6, line 13, delete ", the" and substitute therefor --is a--.

Page 6, line 16, delete "- in".

Page 6, line 16, delete ", the" and substitute therefor --is a--.

Page 6, line 18, delete "- in".

Page 6, line 18, delete ", " and substitute therefor --is a--.

Page 6, line 20, delete "- in".

Page 6, line 20, delete ", " and substitute therefor --is--.

Page 6, after line 21, insert --Description of the Preferred Embodiments--.

Page 7, line 12, before "above" delete "The" and substitute therefor --Referring to Figure 1, the--.

Page 7, line 13, delete "(Figure 1)".

Page 7, line 15, delete "Fillers" and substitute therefor --In examples C and D, fillers--.

Page 7, line 17, delete "(Examples C and D)".

Page 8, line 5, after "installation" insert --shown in Figure 2,--.

Page 8, line 7, delete "(Figure 2)".

Page 8, line 14, delete "or" and substitute therefor --also called a--.

Page 8, line 19, after "bath" insert --14--.

Page 9, delete lines 23-27.

Page 10, line 5, before "ring" delete "said".

Page 10, line 5, before "plurality" delete "said".

Page 10, line 9, before "ring" delete "said".

Page 10, line 10, delete "said".

Page 11, line 5, delete "are" and substitute therefor --were--.

Page 11, line 7, delete "is" and substitute therefor --was--.

Page 11, line 8, delete "is" and substitute therefor --was--.

Page 11, line 10, delete "includes" and substitute therefor --included--.

Page 11, line 11, delete "consists" and substitute therefor --consisted--.

Page 11, line 11, delete "stops" and substitute therefor --stopped--.

Page 11, line 14, delete "is" and substitute therefor --was--.

Page 11, line 16, delete "is" and substitute therefor --was--.



Page 11, line 18, delete "comprises" and substitute therefor --comprised--.

Page 11, line 19, delete "is" and substitute therefor -  
-was--.

Page 11, line 21, delete "comprises" and substitute therefor --comprised--.

Page 11, line 22, delete "is" and substitute therefor -  
-was--.

Page 11, line 24, delete "is" and substitute therefor -  
-was--.

Page 12, line 1, after "that" insert --at--.

In The Claims

Please cancel without prejudice or disclaimer claims 19 and 21.

Please amend claims 1-18, 20 and 22 as follows:

1. (Amended) [Friction] A friction material designed for fitting to a device employing friction in a liquid medium, [such as, in particular, a clutch or brake disc, notably for an automatic gear box or associated therewith, a synchronisation ring or cone for a manually-operated gearbox, characterised in that it consists of] comprising a mat of non-woven fibres impregnated with a thermosetting resin [of the thermosetting type], [and in that the] wherein said fibres have a length of at least 12 mm.

2. (Amended) [Friction] A friction material according to Claim 1, wherein [characterised in that] the average length of the fibres is at most 120 mm.

3. (Amended) [Friction] A friction material according to Claim 2, wherein [characterised in that] the fibres are chosen from [amongst] the group [of fibres] consisting of glass, wool, cotton, ceramic, polyacrylonitrile, preoxidized polyacrylonitrile and aramid.

4. (Amended) [Friction] A friction material according to Claim 3, wherein [characterised in that] fillers in powder form are incorporated into the mat.

5. (Amended) [Friction] A friction material according to Claim 4, wherein [characterised in that the] said fillers in powder form [comprise all or some of the following elements or compounds:] are selected from the group consisting of copper, rockwool, carbon [(coke and/or reduced-powder carbon fibres, graphite)], zirconium silicate, iron sulphide, alumina, rubber and diatoms.

6. (Amended) [Friction] A friction material according to Claim 4 [or 5], [characterised in that] wherein fillers in the form of pulps are incorporated into the mat.

7. (Amended) [Friction] A friction material according to Claim 6, [characterised in that the] wherein said pulps [comprise all or some] are selected from the group consisting of the pulps of glass, aramid, acrylic and phenolic fibres.

8. (Amended) [Friction] A friction material according to Claim 1, wherein [characterised in that] the thermosetting resin [of the thermosetting type] includes a polar solvent[, preferably aqueous].

9. (Amended) [Friction] A friction material according to Claim 8, wherein [characterised in that] the thermosetting resin is resol-based.

10. (Amended) [Friction] A friction material according to Claim 8 [or 9], [characterised in that], wherein latex is added to the thermosetting resin [has latex added to it].

11. (Amended) [Friction] A friction material according to Claim 1, wherein [characterised in that the thermosetting resin has] fillers in powder form are added to the thermosetting resin, and wherein said fillers in powder form are selected from the group consisting of [it which comprise all or

some of the following elements:] copper, rockwool, carbon [(coke and/or reduced-powder carbon fibres, graphite)], zirconium silicate, iron sulphide, alumina, rubber and diatoms.

12. (Amended) [Method] A method of producing a friction material [according to Claim 1], [characterised by the following] comprising the steps of:

- a) providing a mixture of fibres [of the same nature of different natures is produced in a mixer];
- b) carding the mixture [is carded] to form a card web;
- c) lapping the card web to form a lapped card web [is lapped];
- d) needling the lapped card web to form a needled mat of non-woven material [lap thus formed is needled];
- e) impregnating the needled mat [is impregnated] with a thermosetting resin to form an impregnated mat; and
- f) drying the impregnated mat [is dried].

13. (Amended) [Method] A method according to Claim 12, wherein [characterised in that] between steps b) and c), fillers in powder form are sprinkled on the card web, said fillers being selected from the group consisting of [which comprise all or some of the following elements:] copper, rockwool, carbon [(coke and/or reduced-powder carbon fibres,

graphite)], zirconium silicate, iron sulphide, alumina, rubber and diatoms [are sprinkled on the card web].

14. (Amended) [Method] A method according to Claim 12 [or 13], wherein [characterised in that,] before step e), [the thermosetting resin has added to it] fillers in powder form [which comprise all or some of the following elements:] selected from the group consisting of copper, rockwool, carbon [(coke and/or reduced-powder carbon fibres, graphite)], zirconium silicate, iron sulphide, alumina, rubber and diatoms are added to the thermosetting resin.

15. (Amended) [Method] A method according to Claim 12, [characterised in that step e) is preceded by an operation of impregnation of] further comprising the step of impregnating the needled mat with fillers in powder form using [by means of a dilution or dispersion in] a liquid [of] having said fillers in powder form dispersed therein before step e), [which comprise all or some of the following elements:] said fillers in powder form being selected from the group consisting of copper, rockwool; carbon [(coke and/or reduced-powder carbon fibres, graphite)], zirconium silicate, iron sulphide, alumina, rubber and diatoms

16. (Amended) [Method] A method according to Claim 12, [characterised in that] wherein the carding step is effected by [means of a wool-type] a wool card.

17. (Amended) [Method] A method according to Claim 12, [characterised in that] wherein the needling step [operation] is preceded by a preliminary needling [operation] step.

18. (Amended) [Method] A method according to Claim 12, [characterised in that] wherein the [resin impregnation] impregnating step is effected by soaking the needled mat in a tank containing the resin [in solution or] dispersed in water.

20. (Amended) [Method] A method according to Claim 12, further comprising the step of winding up the impregnated mat after the drying step [characterised in that, after or during drying, the mat is wound up].

22. (Amended) [Method] A method according to Claim 12 [or 21], further comprising the step of cutting a ring out from the mat. [characterised in that:

h) a ring, or as a variant a plurality of sectors forming a ring, is cut out from the mat.]

Please add new claims 25-32 as follows:

-- 25. (New) A friction material according to Claim 5, wherein fillers in the form of pulps are incorporated into the mat. --

-- 26. (New) A friction material according to Claim 9 wherein latex is added to the thermosetting resin. --

-- 27. (New) A method according to Claim 13, wherein before step e), fillers in powder form selected from the group consisting of copper, rockwool, carbon, zirconium silicate, iron sulphide, alumina, rubber and diatoms are added to the thermosetting resin. --

-- 28. (New) A friction material according to Claim 8, wherein the polar solvent is an aqueous polar solvent. --

-- 29. (New) A method according to Claim 12, wherein said mixture is a mixture of different fibres. --

-- 30. (New) A method according to Claim 12, wherein the impregnating step is effected by soaking the needled mat in a tank containing the resin in solution in water. --

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-- 31. (New) A method according to Claim 12, further comprising the step of winding up the impregnated mat during the drying step. --

-- 32. (New) A method according to Claim 12, further comprising the step of cutting a plurality of sectors out from the mat, each of said sectors comprising a portion of a ring. --

REMARKS

Applicants respectfully request an early and favorable examination on the merits of this application. In the event that a telephone conference would facilitate prosecution of the instant application in any way, the Examiner is invited to contact the undersigned at the number provided.

Respectfully submitted,

MORGAN & FINNEGAN, L.L.P.

Dated: March 11, 1998

By:   
Ian G. DiBernardo  
Registration No. 40,991

Of Counsel:

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**Friction material designed for fitting to a  
device employing friction in a liquid medium, and  
the method of producing such a friction material  
and the device to which it is fitted**

The object of the present invention is a friction material designed for fitting to a device using friction in a liquid medium, and the method of producing such a friction material and the device to which it is fitted.

More particularly, such a friction material takes the form of a flat ring or a truncated cone and the device to which it is fitted is a clutch or brake disc, notably for an automatic gear box or associated therewith, operating in oil, or a synchronisation ring or cone for a manually-operated gearbox also operating in oil, such a device being installed in a vehicle.

The friction materials used up to now for the aforementioned applications are of three types: materials of the paper type, sintered materials and graphite-containing moulded materials.

The materials of the paper type consist essentially of cellulose fibres impregnated with resin.

They are obtained by a wet method using a normal paper-making process, that is to say by dispersing cellulose fibres in an aqueous solution containing a resin, then spinning and drying.

Such a method necessarily involves using short fibres, with an average length below one millimetre.

Materials of this type have the drawback of degrading very rapidly as soon as their temperature reaches 150°C, which is the case when the device that is equipped with the friction

material must, within a small space, transmit or absorb high torques at speeds which, in practice, are growing ever higher.

This situation now arises by virtue of, on the one hand, the increasing power of thermal engines and, on the other hand, the reduction in the size of the devices for transmitting engine torque, which make it necessary to increase the gripping pressure of the friction devices.

Sintered materials do not exhibit this drawback but, unlike materials of the paper type, the coefficients of friction obtained are low.

Moreover, these materials generate damaging vibrations and noises.

Materials of the graphite-containing moulded type have a relatively high cost price and do not permit stable transmission of a torque.

The aim of the invention is to overcome the aforementioned drawbacks by proposing a friction material for a liquid medium which has in particular a high, stable coefficient of friction, a high resistance to heating at high working pressures, and good resistance to wear.

A friction material for a liquid medium, according to the invention, is characterised in that it consists of a mat of fibres impregnated with a thermosetting resin, and in that the said fibres have a length of at least 12 mm.

According to other characteristics taken separately or in combination:

- the average length of the fibres is at most 120 mm;
- the fibres are chosen from amongst the group of fibres of

glass, wool, cotton, ceramic, polyacrylonitrile, preoxidized polyacrylonitrile and aramid;

- fillers in powder form are incorporated into the mat, comprising all or some of the following elements or compounds: copper, rockwool, carbon (coke and/or reduced-powder carbon fibres, graphite), zirconium silicate, iron sulphide, alumina, rubber and diatoms;

- fillers in the form of pulps are incorporated into the mat, comprising all or some of the following compounds: pulps of glass, aramid, acrylic and phenolic fibres;

- the resin of the thermosetting type includes a polar solvent, preferably aqueous;

- the thermosetting resin has latex and/or fillers in powder form added to it which comprise all or some of the following elements or compounds: copper, rockwool, carbon (coke and/or reduced-powder carbon fibres, graphite), zirconium silicate, iron sulphide, alumina, rubber and diatoms.

The method of producing the friction material according to the invention is characterised by the following steps:

a) a mixture of fibres of the same nature or of different natures as defined above is produced in a mixer;

b) the mixture is carded to form a card web;

c) the card web is lapped;

d) the lap thus formed is needled;

e) the needled mat is impregnated with a thermosetting resin;

f) the impregnated mat is dried.

According to other characteristics taken independently or in combination:

- between steps b) and c) above, fillers in powder form as defined above are sprinkled on the card web;
- before step e) the thermosetting resin has fillers as defined above added to it.
- step e) is preceded by an operation of impregnation of the needled mat by means of a dilution or dispersion in a liquid of the fillers as defined above.
- the carding is effected by means of a wool-type card;
- the needling operation is preceded by a preliminary needling operation;
- the resin impregnation is effected by soaking in a tank containing the resin in solution or dispersed in water;
- drying is preceded by a squeezing or hydroextraction operation;
- after or during drying, the mat is wound up.

As a variant, the method is characterised by the following operations;

- a) a mixture of fibres of the same nature or of different natures, as defined above, is produced in a mixer;
- b) the mixture is carded to form a card web;
- c') fillers in powder form as defined above, and a resin in powder form, are sprinkled on the card web;

d') the mat is pressed while being brought to an appropriate temperature to ensure the flow of the resin.

In order to produce a device coated with friction material, the method according to the invention is as follows:

- g) a ring, or as a variant a plurality of sectors forming a ring, is cut out from the mat produced as indicated above;
- i) the ring or plurality of sectors forming a ring is placed in the bottom of a mould;
- j) a metal support is placed in the mould on the ring or on the plurality of sectors forming a ring;
- k) where appropriate, a second ring or a plurality of sectors forming a ring is placed on the metal support, opposite the said ring or the said plurality of sectors forming a ring;
- l) the mould is closed, shims being disposed so as to control and limit the movement of a piston closing the mould;
- m) heating under pressure is effected in the mould, thereby also ensuring the adhesion of the said ring, and where applicable of the said second ring, to the metal support;
- n) the mould is opened and the device covered with the friction material is cooled.

As a variant, step g) is replaced by a step h) identical thereto, but conducted between steps d) and e) above.

According to other characteristics of the invention, taken independently or in combination:

- the mould and piston have a flat bottom;

- the bottom of the mould is grooved;
- the mould and the piston are in the shape of a truncated cone;
- the shims limiting the movement of the piston are sized so that the porosity of the friction material is between 20% and 70%;
- the heating temperature is between 130°C and 220°C.

Other characteristics and advantages of the product and of the method will appear from a reading of the description that follows, of example embodiments and implementations of the invention, in relation to the accompanying drawings which depict:

- in Figure 1, the functional diagram of a first part of the installation designed for the implementation of the method according to the invention;
- in Figure 2, the functional diagram of a second part of this installation;
- in Figure 3, a diagram illustrating the cutting out of friction rings and sectors;
- in Figure 4, a series of graphs summarizing the results of comparative tests.

Four fibre mats (examples A, B, C, D) are produced from the following compositions by weight of fibres:

FIBRES	EXAMPLES	A	B	C	D
GLASS	- Parts	20	-	20	-
COTTON	- Parts	-	30	-	-
CERAMIC	- Parts	10	10	10	-
PAN (polyacrylonitrile or preoxidized)	- Parts	10	-	10	20

The average length of the fibres used is as follows:

- glass fibres: 50 mm;
- cotton fibres: 18 mm;
- ceramic fibres: 12 mm;
- PAN fibres: 42 mm.

The above fibres or mixtures of fibres, produced in a mixer, are introduced into the hopper 1 (Figure 1) of a feed device 2 for a wool-type card 3 which has a feed chute 4.

Fillers in powder form are sprinkled at the discharge from the card 3, on the card web formed, by means of a sprinkling device 5 (examples C and D).

The fillers in powder form have the following composition (composition by weight referred to the parts by weight of the above fibres):

Fillers IN POWDER FORM EXAMPLES	A	B	C	D
COPPER	-	-	-	10
POWDERED ROCKWOOL	-	-	-	10
GRAPHITE	-	-	10	-
COKE	-	-	10	-

The card web is then lapped by means of a lapper 6, and the lap thus formed undergoes a needling process in two phases: preliminary needling by a preliminary needler with rollers 7

and needling by a needler 8.

The mat of needled nonwoven material thus produced is, in the example depicted, wound on a roll 9 at the discharge from the first part of the installation.

The roll 9 is carried into a second part of the installation and is paid out for the remainder of the process of producing a friction material (Figure 2).

As a variant (not shown), the second part of the installation follows immediately on from the first part and the needled nonwoven mat is not wound up.

The needled mat is fed into a cutting station 10 where rings 11 or sectors 12 as depicted in Figure 3 or any other shape that the friction material is to take are cut out.

The part of the mat that is not cut out, or skeleton, is directed to a winder 13, for subsequent recycling.

The cut-out shapes 11 or 12 are conveyed into an impregnating bath 14 containing one or more resins of the thermosetting type in solution or dispersed in water.

The impregnating bath is of the following composition by weight, expressed in parts, in a manner consistent with the proportions indicated previously for fibres and fillers.

IMPREGNATING BATH EXAMPLES	A	B	C	D
WATER-BASED RESIN	60	60	-	-
RESOL-BASED RESIN	-	-	40	60

In general, the following types of resin can be used:

- phenolic plastic resins (resol or novolak);



- aminoaldehyde resins (urea formaldehyde, melamine formaldehyde or combinations thereof);
- epoxy (epoxide) resins;
- polyimide resins.

At the end of impregnation, squeezing takes place, firstly in the bath (conveyor 16) and outside the bath (rollers 17).

As a variant, not shown, the cut-out shapes 11, 12 undergo, after soaking in the impregnating bath, a hydroextraction operation.

The cut-out shapes 11, 12 are then introduced into an infrared drying tunnel 18, and then packaged.

As a variant, the operation of cutting out the shapes is carried out after impregnation, squeezing and/or hydroextraction and drying.

In the latter case, the impregnated mat can be wound up in order to be transported to a cutting station as shown in Figure 3.

Each cut-out shape, a ring or plurality of sectors forming a ring, is placed in a mould which has, depending on the equipment for which the friction material is intended, a bottom which is flat or in the form of a truncated cone or any other shape, grooved or otherwise.

A metal support is placed in the mould on the ring or plurality of sectors.

Where appropriate, a second ring is placed on the metal support, opposite the said ring or the said plurality of sectors forming a ring.

A metal support is placed in the mould on the ring or plurality of sectors forming a ring.

Where appropriate, a second ring or a plurality of sectors forming a ring is placed on the metal support, opposite the said ring or the said plurality of sectors forming a ring.

The mould is closed, shims being disposed so as to control and limit the movement of a piston closing the mould.

Heating under pressure is effected in the mould, which moreover ensures the adhesion of the said ring, and where applicable of the said second ring, to the metal support.

The mould is opened and the device coated with the friction material is cooled.

Advantageously, the shims limiting the movement of the piston are sized so that the porosity of the friction material is between 20% and 70% and the heating temperature is between 130°C and 220°C.

In order to effect comparative tests with a known friction material of the paper type, two samples of friction material (clutch disc) are produced with the following composition by weight:

- cellulose fibres: 30% (length: 2 to 20 mm);
- phenolic resin: 31%
- diatoms: 23%
- aramid fibres: 10% (length: 6 to 20 mm)
- quartz: 5%
- sodium sulphate: 1%

Four series of three clutch friction discs produced in accordance with the invention from the compositions of the above examples A, B, C and D and two series of three clutch

friction discs of the paper type having the above compositions underwent endurance tests under the conditions indicated hereinafter.

Three discs from the same series, corresponding to the same embodiment, are placed in a testing machine of the type defined by the standard SAE II (US standard).

The test is effected in an oil bath brought to 114°C. A circulation of oil is also provided with a flow rate of between 2 and 3 litres per minute.

The test includes three series of cycles.

Each cycle consists of braking, until it stops, a centrifugal mass previously launched at a rotation speed of 3600 revolutions per minute.

After each cycle the centrifugal mass is relaunched at the speed indicated above.

A 30 second time interval is provided between each cycle start.

The first series comprises 50 cycles where the unit-area pressure of the gripping of the discs is 0.5 Mpa, the inertia being 0.213 m<sup>2</sup>.kg.

The second series comprises 2400 cycles where the unit-area pressure of the gripping of the discs is 1.5 Mpa, the inertia being 0.501 m<sup>2</sup>.kg.

The third series is identical to the first.

The graphs in Figure 4 represent the evolution of the dynamic friction coefficient of each of the six samples during the endurance cycles defined previously.

It will be observed that between 500 and 800 cycles, a paper lining is destroyed while the friction material according to the invention remains intact after 2500 cycles (end of tests).

Furthermore, a remarkable stability will be observed in the coefficient of friction of the material according to the invention during the cycles, at a level very close to that of a paper-type material.

Variant embodiments can be used.

In particular, fillers in the form of pulps can be incorporated into the mat, notably pulps chosen from amongst the group of pulps of glass, aramid, acrylic and phenolic fibres.

It is, moreover, entirely possible to incorporate the fillers into the liquid resin instead of, or in addition to, sprinkling them onto the mat.

The fillers can also be diluted or dispersed in a suitable liquid constituting a first impregnating bath for the mat, a second impregnation then being provided so as to ensure the addition of resin.

Furthermore, it is possible to use a solid resin, in the form of a powder, which is sprinkled onto the mat at the same time as the fillers. This mat is then pressed to the correct thickness at 60°C for 2 secs; in this variant, there is no needling or impregnation.

## CLAIMS

1. Friction material designed for fitting to a device employing friction in a liquid medium, such as, in particular, a clutch or brake disc, notably for an automatic gear box or associated therewith, a synchronisation ring or cone for a manually-operated gearbox, characterised in that it consists of a mat of fibres impregnated with a resin of the thermosetting type, and in that the said fibres have a length of at least 12 mm.
2. Friction material according to Claim 1, characterised in that the average length of the fibres is at most 120 mm.
3. Friction material according to Claim 2, characterised in that the fibres are chosen from amongst the group of fibres of glass, wool, cotton, ceramic, polyacrylonitrile, preoxidized polyacrylonitrile and aramid.
4. Friction material according to Claim 3, characterised in that fillers in powder form are incorporated into the mat.
5. Friction material according to Claim 4, characterised in that the said fillers in powder form comprise all or some of the following elements or compounds: copper, rockwool, carbon (coke and/or reduced-powder carbon fibres, graphite), zirconium silicate, iron sulphide, alumina, rubber and diatoms.
6. Friction material according to Claim 4 or 5, characterised in that fillers in the form of pulps are incorporated into the mat.
7. Friction material according to Claim 6, characterised in that the said pulps comprise all or some of the pulps of glass, aramid, acrylic and phenolic fibres.

8. Friction material according to Claim 1, characterised in that the resin of the thermosetting type includes a polar solvent, preferably aqueous.

9. Friction material according to Claim 8, characterised in that the thermosetting resin is resol-based.

10. Friction material according to Claim 8 or 9, characterised in that the thermosetting resin has latex added to it.

11. Friction material according to Claim 1, characterised in that the thermosetting resin has fillers in powder form added to it which comprise all or some of the following elements: copper, rockwool, carbon (coke and/or reduced-powder carbon fibres, graphite), zirconium silicate, iron sulphide, alumina, rubber and diatoms.

12. Method of producing a friction material according to Claim 1, characterised by the following steps:

- a) a mixture of fibres of the same nature or of different natures is produced in a mixer;
- b) the mixture is carded to form a card web;
- c) the card web is lapped;
- d) the lap thus formed is needled;
- e) the needled mat is impregnated with a thermosetting resin;
- f) the impregnated mat is dried.

13. Method according to Claim 12, characterised in that between steps b) and c), fillers in powder form which comprise all or some of the following elements: copper, rockwool,

carbon (coke and/or reduced-powder carbon fibres, graphite), zirconium silicate, iron sulphide, alumina, rubber and diatoms, are sprinkled on the card web.

14. Method according to Claim 12 or 13, characterised in that, before step e), the thermosetting resin has added to it fillers in powder form which comprise all or some of the following elements: copper, rockwool, carbon (coke and/or reduced-powder carbon fibres, graphite), zirconium silicate, iron sulphide, alumina, rubber and diatoms.

15. Method according to Claim 12, characterised in that step e) is preceded by an operation of impregnation of the needled mat by means of a dilution or dispersion in a liquid of fillers in powder form which comprise all or some of the following elements: copper, rockwool, carbon (coke and/or reduced-powder carbon fibres, graphite), zirconium silicate, iron sulphide, alumina, rubber and diatoms.

16. Method according to Claim 12, characterised in that the carding is effected by means of a wool-type card.

17. Method according to Claim 12, characterised in that the needling operation is preceded by a preliminary needling operation.

18. Method according to Claim 12, characterised in that the resin impregnation is effected by soaking in a tank containing the resin in solution or dispersed in water.

19. Method according to Claim 12, characterised in that drying is preceded by a squeezing or hydroextraction operation.

20. Method according to Claim 12, characterised in that, after or during drying, the mat is wound up.

21. Method of producing a friction material according to Claim 1, characterised by the following steps:

a) a mixture of fibres of the same nature or of different natures is produced in a mixer;

b) the mixture is carded to form a card web;

c') fillers in powder form which comprise all or some of the following elements: copper, rockwool, carbon (coke and/or reduced-powder carbon fibres, graphite), zirconium silicate, iron sulphide, alumina, rubber and diatoms, and a resin in powder form, are sprinkled on the card web;

d') the mat is pressed while being brought to a suitable temperature to ensure the flow of the resin.

22. Method according to Claim 12 or 21, characterised in that:

h) a ring, or as a variant a plurality of sectors forming a ring, is cut out from the mat.

23. Method of producing a device coated with a friction material obtained by means of the method according to Claim 22, characterised by the following steps:

i) the ring or plurality of sectors forming a ring is placed at the bottom of a mould;

j) a metal support is placed in the mould on the ring or on the plurality of sectors forming a ring;

k) where appropriate, a second ring or a plurality of sectors forming a ring is placed on the metal support, opposite the said ring or the said plurality of sectors forming a ring;



l) the mould is closed, shims being disposed so as to control and limit the movement of a piston closing the mould;

m) heating under pressure is effected in the mould, thereby also ensuring the adhesion of the said ring, and where applicable of the said second ring, to the metal support;

n) the mould is opened and the device covered with the friction material is cooled.

24. Method of producing a device covered with a friction material according to Claim 23, characterised in that the shims limiting the movement of the piston are sized so that the porosity of the friction material is between 20% and 70%.

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## ABSTRACT

**Friction material designed for fitting to a device employing friction in a liquid medium, and the method of producing such a friction material and the device to which it is fitted**

A friction material for a liquid medium, according to the invention, consists of a fibre mat impregnated with a thermosetting resin, the fibres having a length of at least 12 mm.

The method of producing such a material includes the following steps:

- a) a mixture of fibres of the same nature or of different natures is produced in a mixer;
- b) the mixture is carded to form a card web;
- c) the card web is lapped;
- d) the lap thus formed is needled;
- e) the needled mat is impregnated with a thermosetting resin.

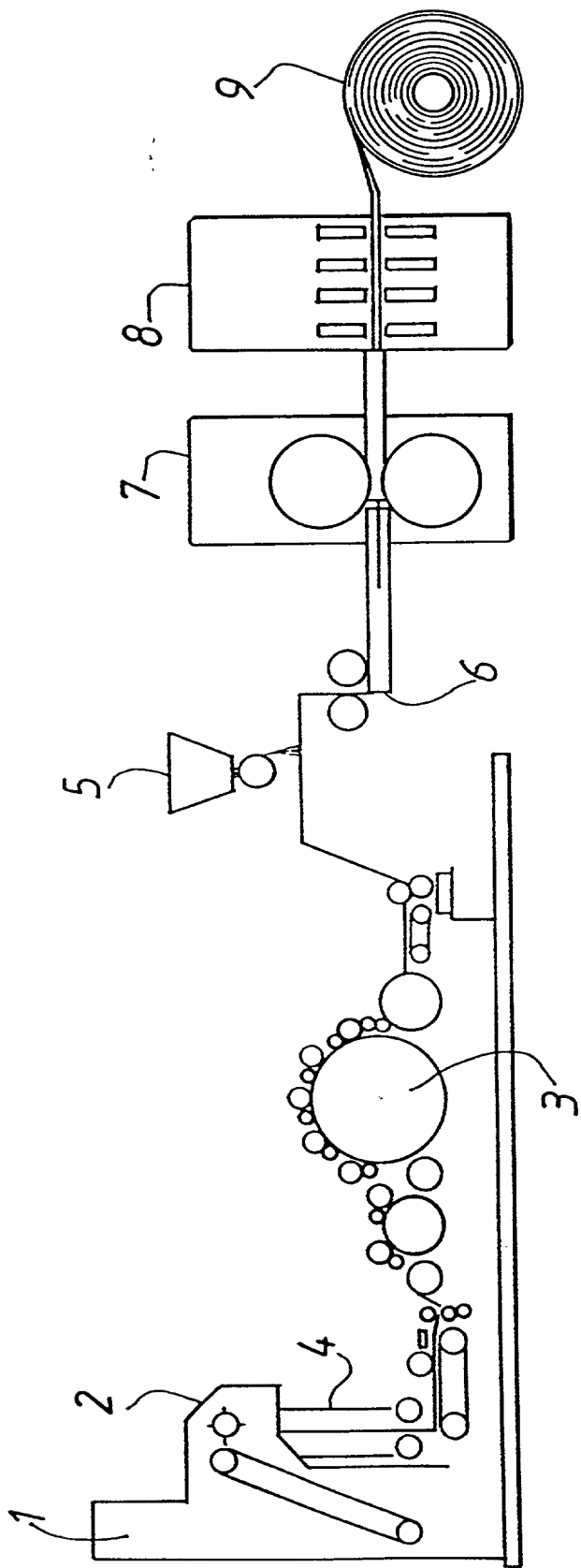


FIG. 1

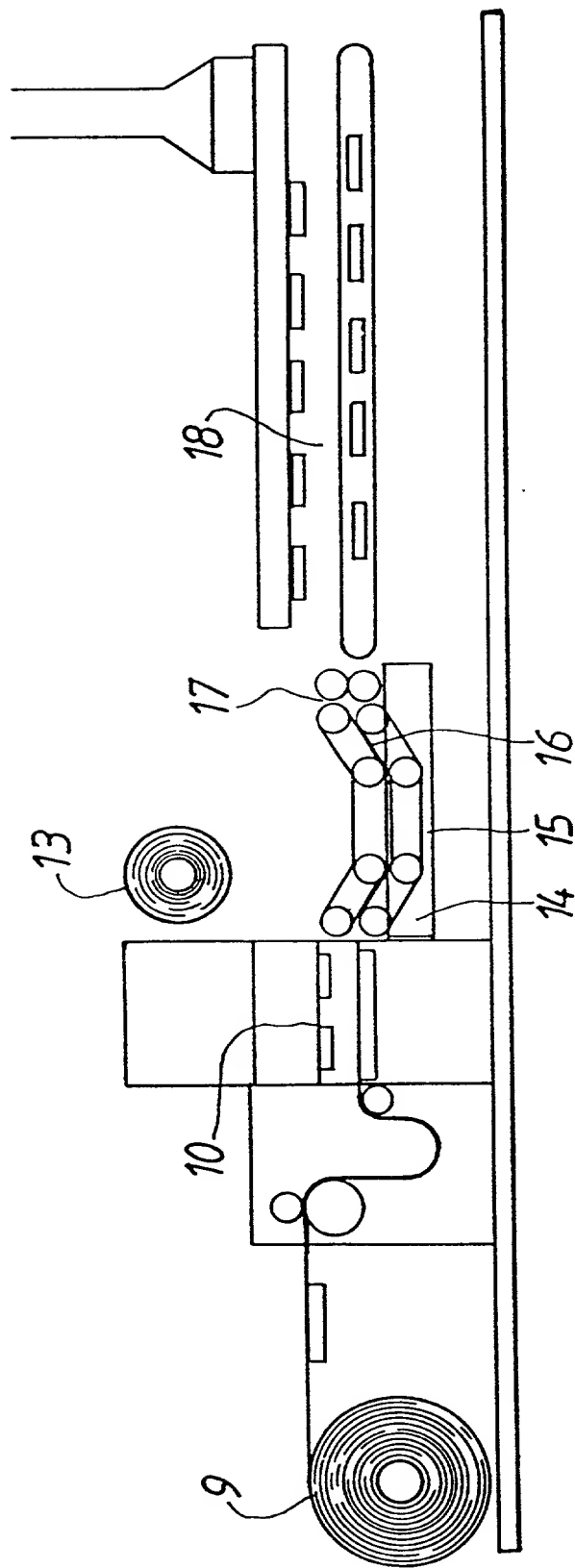


FIG. 2

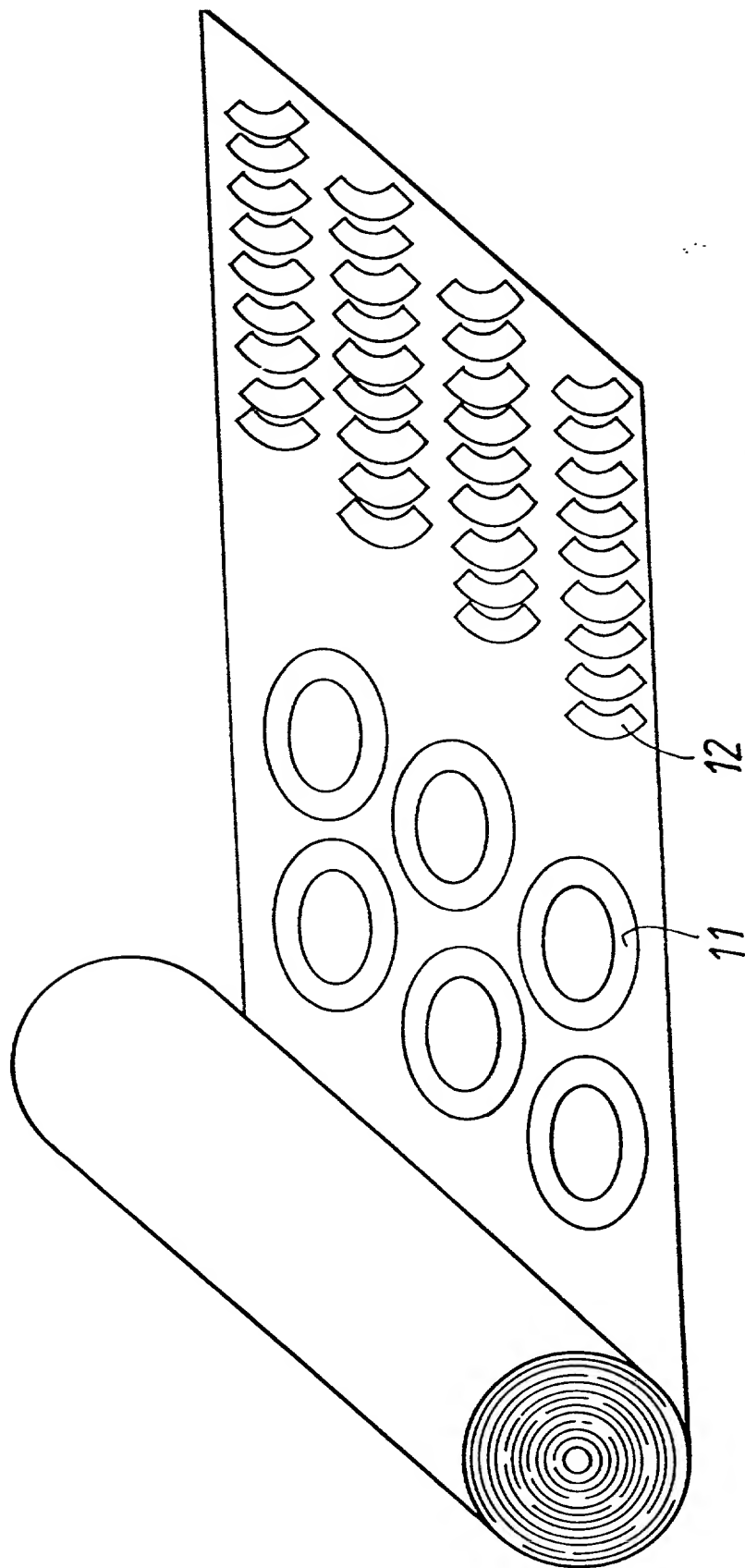


FIG. 3

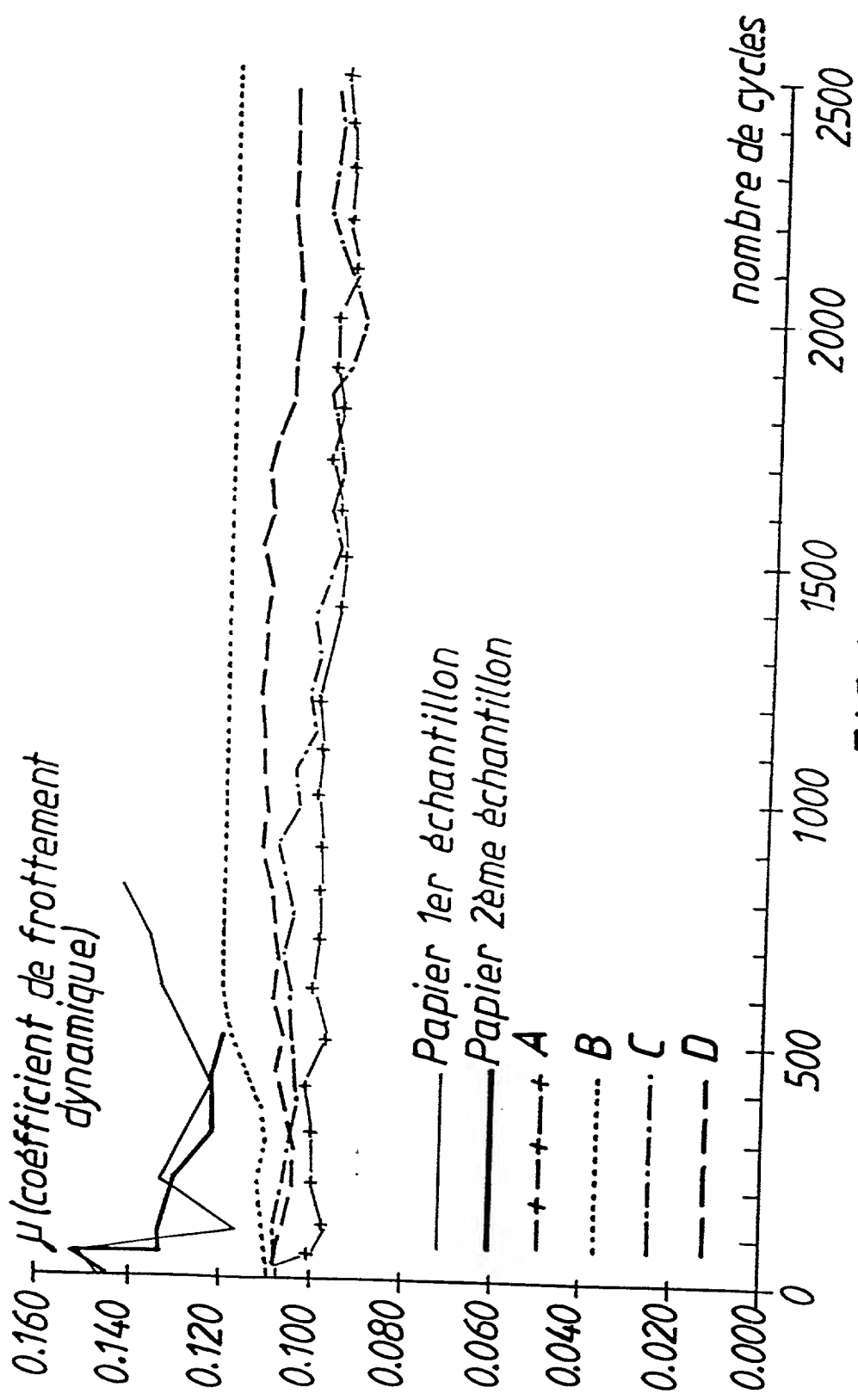


FIG.4

I, the below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled Friction material designed for fitting to a device employing friction in a liquid medium, and the method, the specification of which of producing such a friction material and the device to which it is fitted.

(check one) ☒ is attached hereto.

☐ was filed on \_\_\_\_\_

Application Serial No. \_\_\_\_\_ as

and was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed
94 03518	FRANCE	25th March, 1994	X
(Number)	(Country)	(Day/Month/Year Filed)	Yes No
(Number)	(Country)	(Day/Month/Year Filed)	Yes No
(Number)	(Country)	(Day/Month/Year Filed)	Yes No

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

PCT/FR95/00320	16/MARCH/1995	
(Application Serial No.)	(Filing Date)	(Status—patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(Status—patented, pending, abandoned)

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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In the matter of  
PCT Patent Application No PCT/FR 95/00320  
In the name of  
VALEO

**DECLARATION**

I, Peter Johnson, BA MITI, of 34 Ledburn, Skelmersdale,  
Lancashire, WN8 6TX, hereby certify that to the best of my  
knowledge and belief the following is a true translation made  
by me, and for which I accept responsibility, of PCT Patent  
Application No PCT/FR 95/00320  
in the name of VALEO

Signed this 9<sup>th</sup> day of November 1995

.....  
PETER JOHNSON